FORUM

Using Genetic Tools To Combat Hunger

Walk into any grocery store and you will see it for yourself: We are producing an unprecedented bounty of food. Having such an abundant food supply begs the question: Why work so hard at improving our crops and livestock when we are already so successful? The answer is simple. We live in a changing world.

The world's population, now at 6.8 billion people, has more than doubled since the 1950s and is expected to reach 9 billion by 2050. The United Nations Food and Agriculture Organization predicts that food production will need to double by 2050 to meet the increased demand. Water supplies will also be a concern as the need to irrigate crops competes with demands from thirsty cities and suburbs in places as diverse as Beijing, New Delhi, and Phoenix.

Climate change is altering landscapes in ways we are only beginning to understand, affecting air temperatures, rainfall patterns, soil dynamics, and the seasonal cycles so vital for a bountiful harvest. Some experts predict that warmer temperatures will reduce yields and cause global food shortages.

New threats from pests and pathogens are also emerging. Ug99, a fungal pathogen, has become an international threat to wheat supplies since its discovery was reported in Uganda a decade ago. Sheath blight, considered the world's worst rice pathogen, has emerged as more of a danger since the 1970s, when scientists developed higher yielding rice varieties.

Chemical and agronomic solutions to pest, weed, and pathogen problems continue to evolve. Some research taps into the genetics and physiology of mosquitoes, ticks, and other pests to find environmentally sound treatments that will target specific arthropods by exploiting how they breathe, feed, shed cells, and reproduce.

When we talk about food supplies, we need to consider livestock health as well as human and crop health. For example, to subsistence farmers in sub-Saharan Africa and many other developing areas, bovine diseases can mean the difference between success and starvation by threatening just a few head of cattle.

To address these challenges, scientists are deciphering the DNA of our most important crops and livestock and tapping into genes that offer enhanced nutritional value, increased resistance to pests and diseases, and the ability to survive in changing climates. ARS researchers have been leading the way, unlocking genetic clues that have been instrumental in the development of beef and dairy cattle that are more productive and varieties of wheat, rice, corn, beans, and potatoes that are hardier and more nutritious.

You can read about some of these projects in this issue. For example, scientists in Stuttgart, Arkansas, are using DNA markers to identify rice varieties with genetic resistance to sheath blight. Other teams—in Beaumont, Texas, and New Orleans, Louisiana—are using rice genes to unlock nutrients in a new variety of high-fiber rice that may create a buzz with its distinct purple color.

Much of the research has an international reach. ARS scientists in Stoneville, Mississippi, are working with colleagues in Paraguay to identify genes that resist Asian soybean rust, a worldwide threat to soybeans. In Beltsville, Maryland, scientists are broadening the genetic base of beans to identify genes that resist the rusts that damage harvests in Africa and the Americas.

Another Beltsville team is working with farmers in Africa to breed hardier and more productive cattle by using technology developed by ARS scientists with help from international colleagues. The Illumina Bovine SNP50 BeadChip, a glass slide containing thousands of DNA markers, can identify useful genetic traits and has already proved to be a key tool in the United States for genotyping bulls that will sire offspring with desirable milk production traits.

To address the threat posed by Ug99, ARS researchers at several locations are collaborating with scientists in Kenya and at the International Maize and Wheat Improvement Center in Mexico to explore the genetics of both wheat and the pathogen.

In Aberdeen, Idaho, ARS scientists have produced potato varieties with increased protein and vitamin C content and are collaborating with Mexican scientists on field trials designed to find potatoes that resist late blight fungus, the pathogen that caused the Irish potato famine.

In some areas of sub-Saharan Africa, people get up to 60 percent of their calories from corn, which is very low in vitamin A. This diet can lead to vitamin A deficiencies that cause infant mortality, eye diseases, and blindness among children. ARS scientists in Ithaca, New York, discovered two varieties of corn that could increase vitamin A levels 15-fold. And researchers at the Children's Nutrition Research Center in Houston, Texas, have shown that Golden Rice-2, a variety 20 years in the making, will be effective at fighting vitamin A deficiencies.

We must grow our food smarter, with less water and on landscapes altered by climate change and threatened by evolving diseases and pests. ARS scientists are addressing that challenge, using genetics to develop crops and livestock that are more resilient and more nutritious. The work is a necessity not only for our health, but also for our survival in a changing world.

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